MONTHLY WEATHER REVIEW.

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The MONTHLY WEATHER REVIEW is based on data from about 3500 land stations and many ocean reports from vessels taking the international simultaneous observation at Greenwich noon.

Special acknowledgment is made of the data furnished by the kindness of cooperative observers, and by R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Government Meteorologist, Kingston, Jamaica; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba.

As far as practicable the time of the seventy-fifth meridian is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

IN GENERAL.

In September the distribution of atmospheric pressure over the globe undergoes marked changes. The continents of the Northern Hemisphere begin to cool and the flow of atmospheric tides from the oceans to the continents begins. It is a month of increasing storm activity. The West Indian hurricane season is at its height. The latter part of the month usually marks the beginning of the rainy season on the Pacific coast of the United States. Over the Florida Peninsula September generally shows the maximum monthly rainfall of the year.

September, 1907, conformed rather closely to the seasonal average. During the early portion of the month barometric pressure was low over the tropical regions of the Atlantic and eastern Pacific, and averaged high over the more northern parts of the oceans. Over the continents the barometric fluctuations of this portion of the month were frequent, but not marked, and the more severe disturbances were of a local character. The third decade of the month was stormy. Two disturbances of tropical origin advanced from the Gulf of Mexico northeastward, attended by heavy rains and high winds along the Atlantic seaboard, and past eastward over the Atlantic to the British Isles, where barometric pressure continued low after the 23d. The first of these storms apparently moved southeastward from the British Isles and united with a disturbance that had caused exceptionally heavy rains over southwestern Europe. During the early part of this decade the first severe autumnal storm of the season crost the Great Lakes. Following the passage of this storm the first heavy frost of the season occurred in the States of the upper Mississippi and middle Missouri valleys and the western Lake region, and the first light frost of the season in the Ohio Valley and the Middle Atlantic States. On the 15th and 16th the first well-marked storm of the season visited the north Pacific coast.

The following dispatch from Kingstown, Island of St. Vincent, British West Indies, dated September 20, 1907, indicates the character of disturbances that occurred in that section during the prevalence of low barometric pressure over the tropical regions of the oceans:

> Recent advices from the Weather Bureau at Washington were verified in a remarkable manner. A disturbance east of the Windward Islands, which had been announced as probable, developed yesterday into a thunderstorm of great severity. Exceedingly low thunderclouds hung over St. Vincent, and the lightning was fearfully vivid. Several casualties occurred. Similar storms have been experienced in the northern islands.

BOSTON FORECAST DISTRICT.*

[New England.]

The average rainfall exceeded that of any September since 1888. Thunderstorms were unusually prevalent, and were severe in parts of New Hampshire and Vermont on the 11th and 30th, and in Massachusetts on the 21st. Temperature averaged above normal. Killing frost occurred in the interior of Maine on the 19th, and a heavy frost was general, except in coast sections, on the 27th. Heavy rain from the 2d to 5th relieved the severe drought that had prevailed in southern New England during the preceding two months. On the 29th easterly gales caused more or less damage to shipping. Storm warnings were issued on the 23d and 29th, and there were no storms without warnings.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*

[Louisiana, Texas, Oklahoma, and Arkansas.]

The month was unusually warm and dry, and no frost occurred. Storm warnings were displayed on the Louisiana and Mississippi coasts on the 21st and 28th on account of a disturbance in the central Gulf, but no gales occurred on those coasts.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*

[Kentucky and Tennessee.]

Temperature was, on the whole, seasonable, and rainfall was below the normal, except in eastern Tennessee, where heavy rain fell on the 21st and 22d. The first light frost of the season occurred over a large portion of Kentucky on the 26th. Hailstorms caused considerable damage in Kentucky on the 2d and 7th.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*

[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

Two storms of moderate energy crost the Lake region during the third decade of the month. Warnings were ordered well in advance of these storms, and no damage to shipping was reported. Frost occurred in the Northwest early in the month. The coldest weather of the month attended an area of high barometer that appeared on the northeastern Rocky Mountain slope on the morning of the 24th. By the morning of the 25th the frost line had extended southward to central Illinois

and eastward to Lake Michigan, and by the following morning had covered the entire eastern section of the district. Warnings were ordered in advance of this condition in nearly all States threatened, with the exception of the central sections on the 25th. Local frosts occurred in the cranberry marshes of Wisconsin on several dates, and special warnings were issued in every case in advance of them.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.*

[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

The month presented no marked abnormal features. There was less than the average amount of precipitation generally thruout the district, and in Utah the mean temperature was somewhat below normal. Frost was confined to central and northern portions of the district, and at moderate elevations was generally light. Accurate and timely warnings were issued of frost that occurred in agricultural sections.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†

[California and Nevada.]

The month was unusually cool in the Sacramento and San Joaquin valleys. Light rains occurred along the coast and showers and thunderstorms in the Sierra and Nevada on the 3d, 4th, and 5th. Light rain fell in the extreme northern portion of California on the 17th, 24th, and 27th, and light snow in the Sierra on the 28th. No frost or storm warnings were issued.—*G. H. Willson, Local Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†

[Oregon, Washington, and Idaho.]

The month was unusually quiet and temperature and rainfall were nearly normal. Storm warnings were ordered on two dates for minor disturbances, and all frosts were successfully forecast.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

There was little of interest during the month, and no floods occurred, except along the lower portion of the James River, in which the stages reached exceeded the flood line. Warnings were issued for the Ocmulgee and Oconee rivers in Georgia, the Wateree River in South Carolina, the James River in Virginia, and for the Binghamton district in New York.

No damage has been reported, except from the Binghamton district where the excessive rains caused washouts in the railroad beds and flooding by backwater from the sewers.

The highest and lowest water, mean stage, and monthly range at 202 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

* Morning forecasts only; night forecasts made at Washington.
† Morning and night forecasts.

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

ON ATMOSPHERIC CURRENTS AT VERY GREAT ALTITUDES.

By Prof. C. C. TROWBRIDGE. Contributed from the Phoenix Physical Laboratory, Columbia University, New York, N. Y., September 5, 1907.

In a recent abstract[1] the writer gave a brief summary of the results of a study of the luminous and long-enduring streaks or trains which are occasionally formed by large meteors. A complete discussion of the physical nature of these trains, with some additional facts recently determined, will appear shortly in the Astrophysical Journal.[2] The present paper relates to the atmospheric currents which are shown to exist in the extreme upper regions of the atmosphere of the earth by the observed drifting of these luminous trains.

The systematic observation and study of meteor trains is of much importance to meteorology because it is the only means by which the presence as well as the direction and velocity of atmospheric currents at very great altitudes above the surface of the earth can be determined. There has been little, if any, systematic work done in this direction heretofore. It is possible that one of the chief reasons for this fact is that the observations of meteor trains have been made almost entirely by astronomers, often in an incidental manner when engaged in other work; while the results obtained relating to the atmosphere and principally of interest to meteorologists have been published in astronomical journals and hence overlookt by those most interested in the subject.

Meteor trains are apparently self-luminous clouds which are usually deposited by large meteors, and particularly those that are swift moving, like the Leonids and Perseids. Astronomers who have made frequent meteor observations are familiar with the phenomenon, but few have taken up the matter further than to make records of the trains which they have seen. There are some notable exceptions. E. E. Barnard is the author of a paper entitled "Drifting meteor trains",[3] in which he gave the directions and rates of drift of five trains seen at Nashville, Tenn., having southeasterly and northeasterly drifts, and called attention to the importance of the observation of meteor-train drifts as a means of studying the movements of the atmosphere. W. F. Denning and A. S. Herschel have referred on many occasions to the drifts in England, and in a number of cases have calculated the altitude and in some the rate of drift of trains. H. A. Newton, C. A. Young, E. E. Barnard, and others have reported them in the United States from time to time. The astronomical journals contain records of train observations made in various countries all over the world.

The study of meteor trains was undertaken by the writer in order to find an explanation of the mysterious persistent luminosity of trains seen at night in the light of recent advances in physics, particularly relating to the conduction of electricity in gases, recombination of the gaseous ions, etc., and a solution of this problem seems promising. In the course of the work there has been found much valuable material relating to the movements of the upper currents in our atmosphere, which is brought together in the present paper.

Many of the trains studied are those which occurred from 1860 to 1870, when meteor observations were more numerous than usual, owing to the interest in the great Leonid showers of 1866, 1867, and 1868, but some of the most important records are of recent date. A number of bright trains were seen during the Leonid shower of 1901. In working up the records it was frequently necessary to determine the direction of the atmospheric drifts by reference to a celestial globe, for in many cases the movements of the trains with respect only to stars were found in the records.

The train drifts given in the present paper do not represent all the recorded observations on the subject, for, owing to the magnitude of the work, it has been possible for the writer to cover only a portion of the field, and the conclusions drawn are thus necessarily based on but a part of the available material. However, over sixty observations of meteor-train drifts have been found. These are given in Tables

[1] Physical Review, June, 1907, p. 524.
[2] Astrophysical Journal, XXVI, 2, Sept., 1907.
[3] Sidereal Messenger, I, 174, 1883; reprinted in 1891.